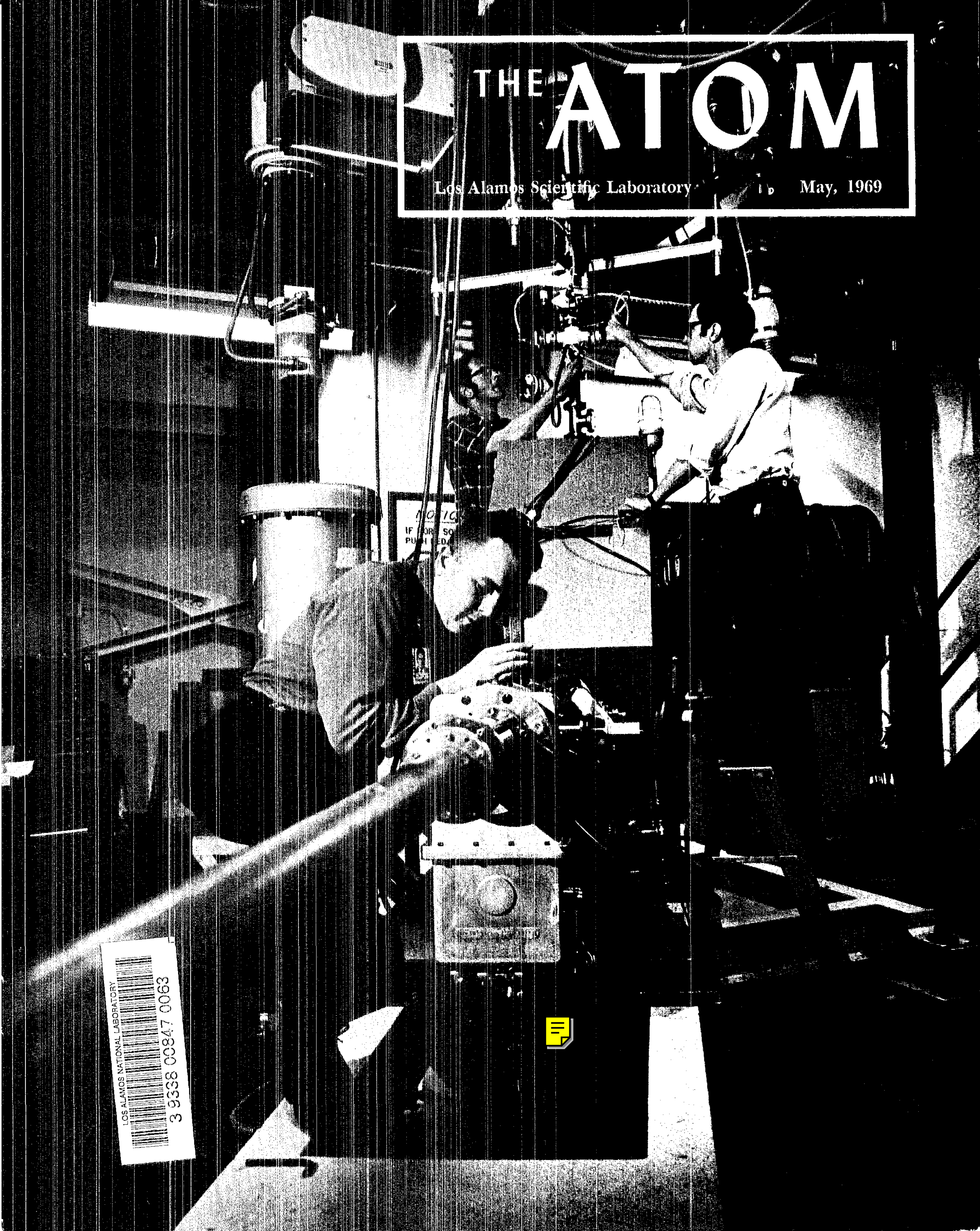
THE ATOM

Los Alamos Scientific Laboratory May, 1969



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THE ATOM

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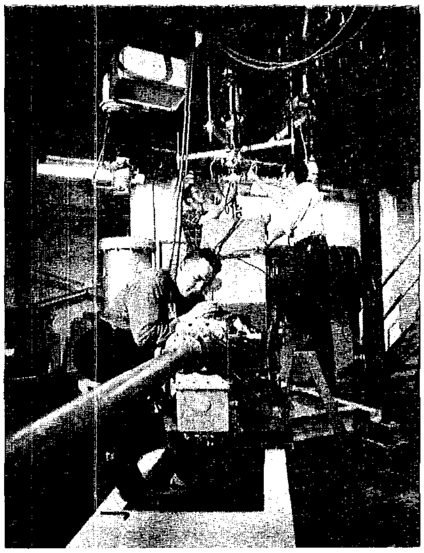


COVER:

Albert Evans, foreground, adjusts the beam defining slits on the N-6 three MeV Van de Graaff accelerator as Gary Worth and Merlyn Krick inspect the beam tube above the 90-degree analyzing magnet. The high current Van de Graaff was installed, only recently, at the Nuclear Safeguards Research laboratory at Ten site. The story of LASL's Nuclear Safeguards Research and Development program begins on page 10.

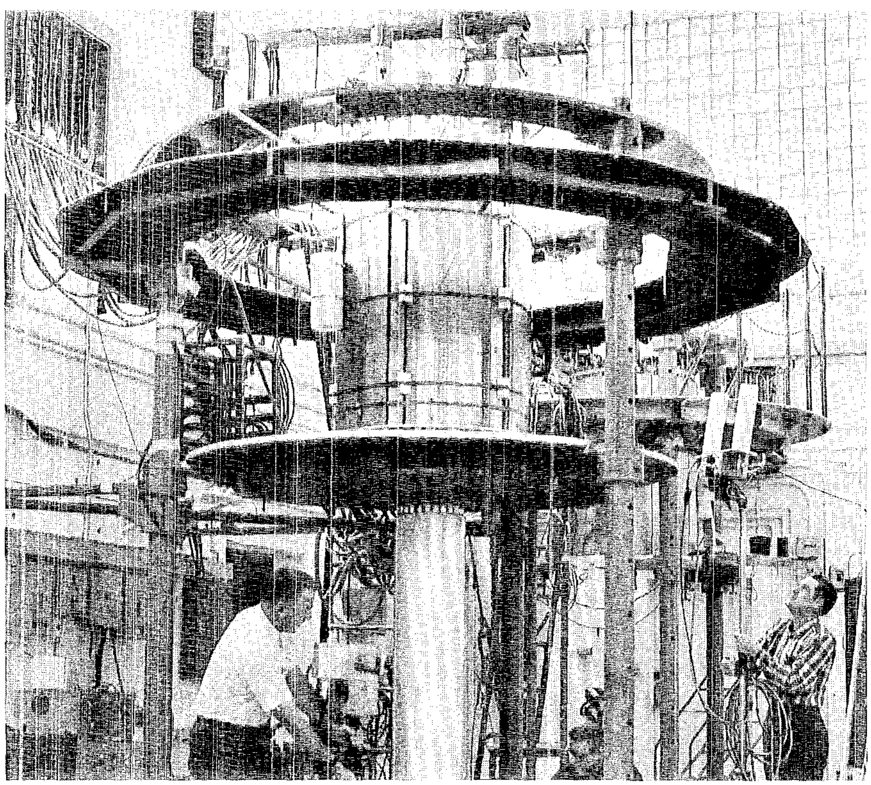
NUCLEAR: "... propelled by, produced by, or relating to atomic power ..."

FURNACE: "... an apparatus for the production or application of heat ..."

—*Webster's Third International Dictionary*

By Bill Richmond

Herb Newman, N-3, Bert Helmick, N-2, and Bill Geer, N-2, prepare to raise the core of the Nuclear Furnace into postion in one of the Kivas at Pajarito Site.



The heart of a nuclear rocket reactor is the core . . . and the guts of the core are the fuel elements.

A process of developing new fuel elements, as well as refining existing ones, is continually being conducted by scientists of the Los Alamos Scientific Laboratory, particularly in connection with the Rover program.

These fuel elements consist of a fissile material—normally uranium. In most reactors the uranium is dispersed in a matrix material which is then coated to prevent the corrosion of the fuel element or the escape of fission products.

And these elements must be tested—as cheaply, as quickly and as realistically as possible.

Enter the Nuclear Furnace, a testbed reactor that can be utilized for evaluation of fuel elements under fairly realistic conditions without the expense of a full-scale reactor test. In addition, a turnaround time of about a month between tests may be possible with the Furnace as compared to nine to twelve months with Pewee, currently the best fuel element test reactor. The Furnace has a number of advan-

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Nuclear Furnace . . .

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tages over reactors regarding the testing of elements which will be discussed later.

The design and development of the Nuclear Furnace system—and its subsequent testing in early 1970—is being handled in two major efforts. Herb Newman, assistant N-3 group leader, heads the project which has the responsibility for designing the Furnace while Charles Fenstermacher, J-18 group leader, is in charge of a team concerned with the design of the effluent cleanup system. This latter work may lead to utilizing the Furnace at Los Alamos for fuel element testing and eliminate the requirement that the reactor be tested at the Nuclear Rocket Development Station in Nevada.

The story behind the Furnace aptly fits the old saw "Necessity is the mother of invention."

As Newman says, "We want to learn how to improve our present fuel elements and we'd like to develop new elements." A vital part of this research includes testing them under the right environmental conditions.

Presently there are two methods by which fuel elements destined for the Rover program can be tested: by insertion in the core of a reactor to be run at NRDS and by the electrical resistance heating method at LASL. Both methods have a number of drawbacks.

The turnaround time for a reactor test in Nevada is 9-18 months. Thus, the scientists may have to wait for more than a year to prove out their theories regarding fuel element development. In addition, it is expensive to conduct a hot test of a reactor so a number of other tests relative to the Rover program—such as materials and gas flow—are conducted simultaneously. Therefore, the number of new elements tested as well as the type of tests that can be held are limited.

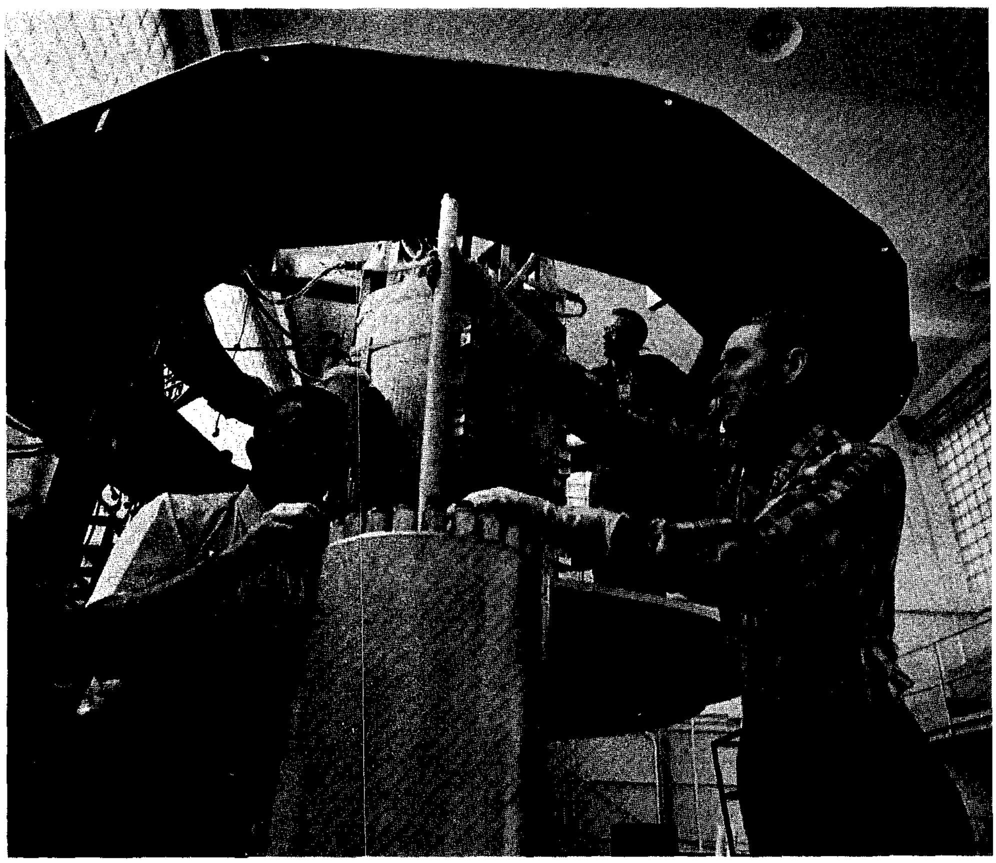
The electrical tests are designed to simulate, as nearly as possible, the reactor environment in order to obtain data on the corrosion rate of fuel elements. The element is heated electrically while hydrogen flows through it. Temperatures up to 5,000°F and pressures of 1,200 psi can be reached in this testing method at LASL. Unfortunately, this method also has a number of deficiencies such as the requirement that electrical grips hold the elements. This additional restraint often causes thermal stress cracks to occur in the fuel element, resulting in premature failure.

"Scientists have looked for years for better ways of testing elements than by electrical testing," Newman said. "It was talked about for years but nothing ever came of it."

Those involved in the Rover program were interested in reactor designs covering a wide range of sizes. Studies had been completed for the large sizes, and were subsequently being investigated for the smaller ones, when it became apparent that a rather small critical system could be constructed which would meet the requirements for another approach to testing fuel elements.

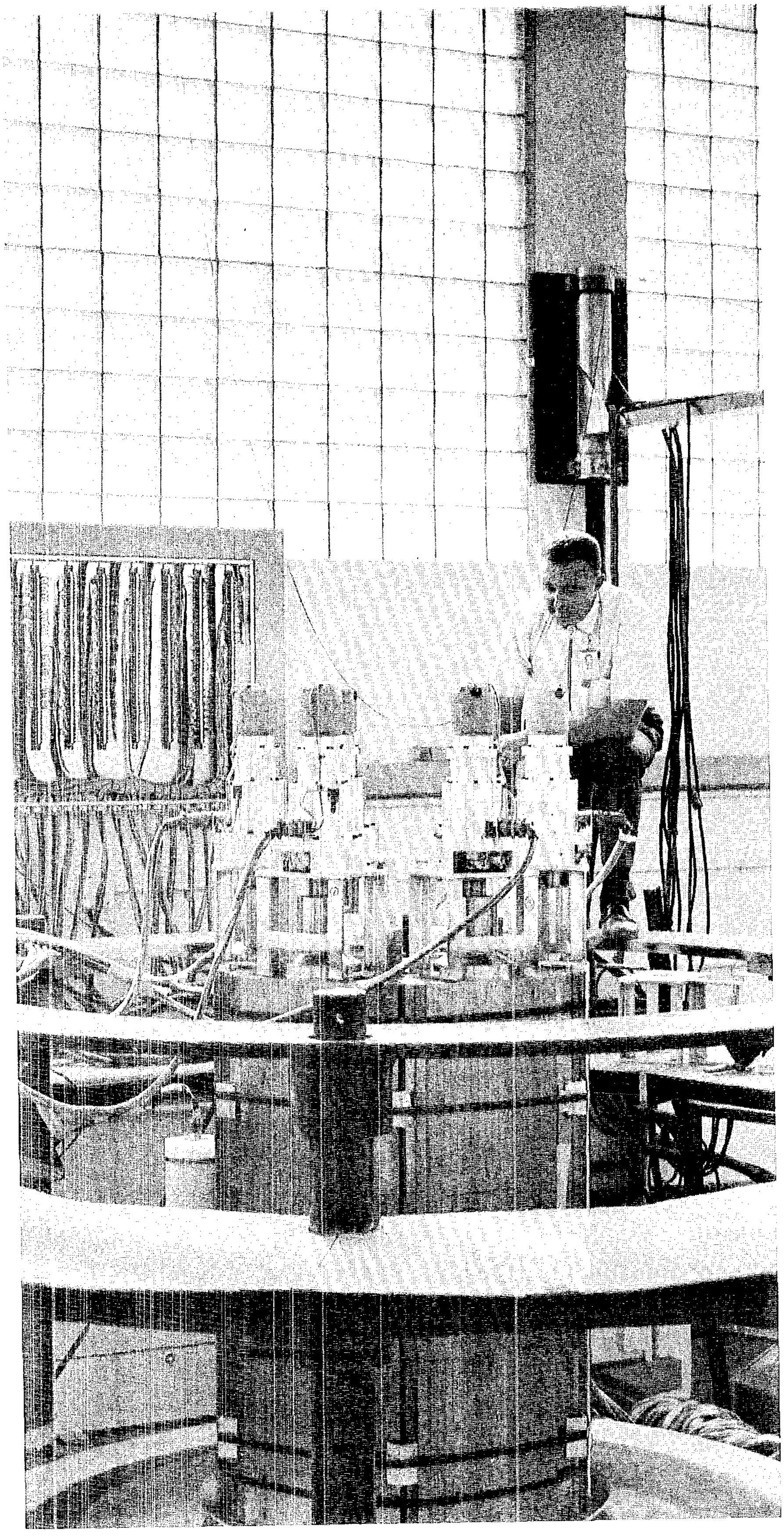
Phoebus 2A reached a power level of slightly over 4,000 megawatts (MW); Phoebus 1 operated at 1,400 MW with a third as many fuel elements as 2A; and Pewee ran at about 500 MW in its initial test last December with only one-tenth the number of elements of Phoebus 2A.

The Furnace-project personnel, however, were looking for something in the range of 100 MW or less with a relatively small number of elements. They conducted surveys of small reactor systems, looked at possible cell concepts



Newman and Geer insert a fuel element can into the Furnace core. Helmick is in the background.

Newman is in charge of the project which has the responsibility for designing the Nuclear Furnace. He inspects the control drums "borrowed" from the Phoebus reactors.



where one could maintain the fuel element in the proper environment, and instead of a fast-neutron system, looked at a moderated system.

In their search, they concentrated on using existing hardware from the Phoebus and Pewee reactors to keep the cost down and to utilize data already collected from prior reactor tests.

The Nuclear Furnace, which will generate about 50 MW of power with only one per cent the number of elements in Phoebus 2A, is what they came up with.

The objective of the Furnace design concept is to provide a repetitive, low-cost method of testing fuel elements with nuclear heating closely matching that experienced in the Phoebus and NERVA (Nuclear Engine for Rocket Vehicle Application) reactors.

"In the Furnace we will test only fuel elements and not supporting hardware as we will in Pewee," Newman said. However, it is also possible that modifications to the Furnace could be made and thence other tests of interest in the Rover program could be conducted.

"In the Phoebus and Pewee reactors we have to dispose of the pressure vessel and related hardware in addition to the core after each hot run," he noted. "But in the Furnace we will pull out the core, conduct the postmortem checks on it, dispose of it alone and reuse the remainder of the hardware in other tests. Thus, we have a faster turnaround time between tests. Perhaps a month as compared to a year or more with other Rover reactors."

This process is made possible partly because there is less total radioactivity in the core because of the small number of fuel elements and partly because the

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Nuclear Furnace . . .

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Nuclear Furnace was designed with this objective in mind. The Phoebus reactor was designed for a high power-to-weight ratio suitable for a flight engine and the Pewee reactor was designed to simulate flight-weight reactor conditions, although it never is intended to fly. These reactors, therefore, had other constraints that made core replacement virtually impossible.

In addition, unlike other reactors tested at NRDS, the Furnace will be fired downward into an effluent cleanup system. This system will be covered in more detail later on. Also, the Furnace will be encased in a new radiation shield which completely covers it.

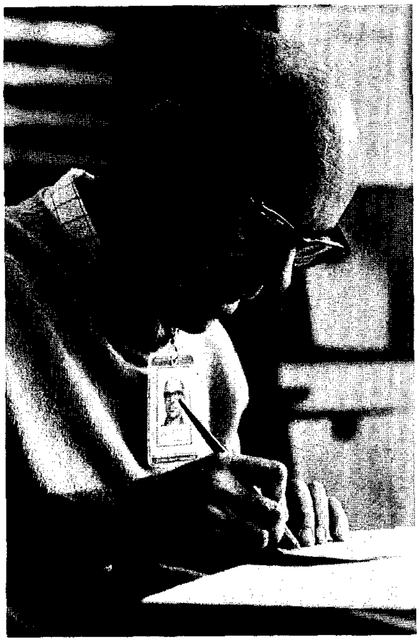
Besides the cost savings realized by reusing hardware for several tests, additional savings were realized by securing existing hardware that was originally built for the Phoebus and Pewee reactors.

"We are using the Pewee 1 pressure vessel plus the Phoebus 2A beryllium reflector system and control system (with certain additions), Phoebus control drums, and the existing test cars at NRDS will be slightly modified for our use," Newman said. Water will be used as a moderator and coolant at a flow rate of about 400 gallons per minute.

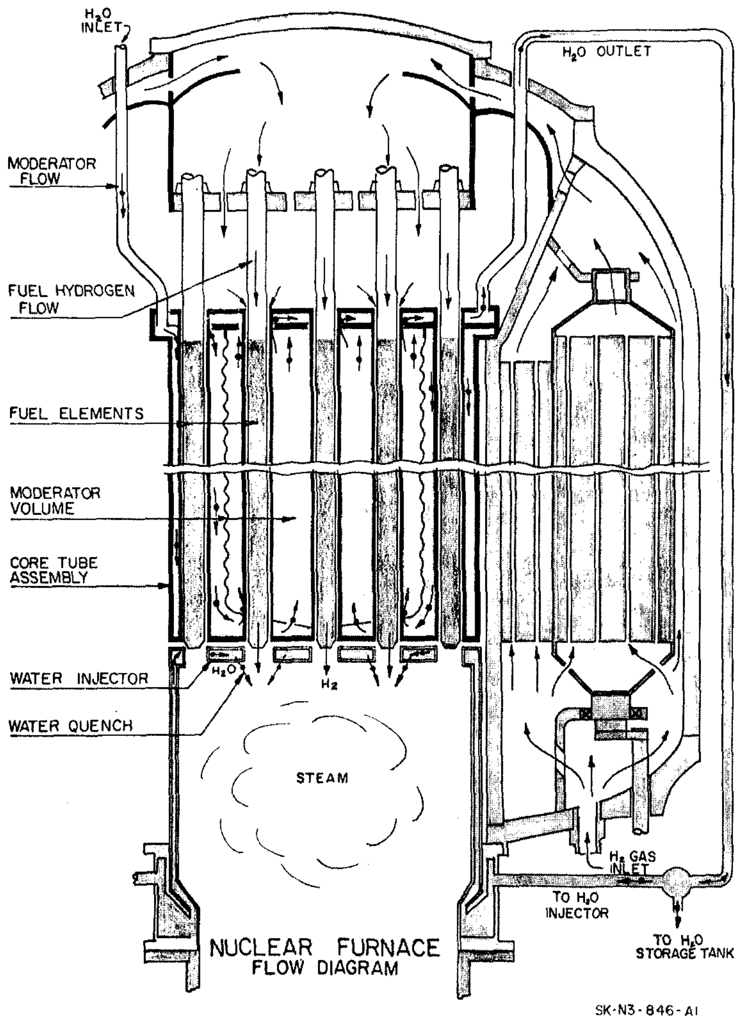
Three sets of the hardware from the Phoebus and Pewee systems are available. One will remain in Los Alamos for testing in the Kivas at Pajarito Site, one will be shipped to NRDS for use there and the third will be a backup set.

In the Nuclear Furnace, each fuel element will be separated from its neighbors and will not be dependent on them as is the case in other reactors. "We can run a number of different test elements, or we can remove some elements to run tests of radioactivity on certain materials and still achieve criticality," Newman said.

When tested, the Furnace will be placed on the test car, taken to Test Cell "C," run by firing down-



Charles Fenstermacher, J-18 heads a team concerned with the design of the effluent cleanup system. Below is a flow diagram of the Nuclear Furnace.



ward, and then removed to the R-MAD (Reactor-Maintenance, Assembly and Disassembly) building. Here the core-tube assembly containing the fuel elements and the moderator will be remotely removed. This will leave the pressure vessel, reflector system, chill-down system and other hardware intact. A new core can then be remotely reinstalled and another test performed.

As one example of economy, the cost of the discarded hardware per test in a Nuclear Furnace is only about seven per cent of that of a Pewee and it takes only about 10 per cent as many fuel elements.

It is hoped that the Nuclear Furnace will be capable of being operated at power densities, temperatures and clapsed times equal to or greater than previous nuclear rocket reactor designs.

The need for full-scale reactor tests will not be eliminated by the Furnace. In all probability, it will not replace the electrical tests presently being conducted for quality assurance evaluation of graphite elements. However, it is felt by many that the Furnace will bridge the gap between electrical tests and full-scale reactor tests, and may virtually replace electrical tests of thermal stress-prone elements such as the composites and carbides.

And now, back to the effluent cleanup system.

This cleanup system will be constructed on the pad at Test Cell "C" east of the hookup facilities for the test car and reactor. It is upon the success of this system that the decision will be made as to the feasibility of constructing a Furnace test facility—with accompanying cleanup system—at LASL.

"The Furnace is basically another reactor, " Fenstermacher says, "so we tried to build an effluent cleanup system that will absorb all the energy from the reactor exhaust plus clean up the exhaust to remove all fission products.

"The major incentive for designing the system was to demonstrate the feasibility of running a reactor like the Furnace in a populated place such as Los Alamos and not necessarily in a remote area."

Other reactors currently in use as power reactors have an effluent cleanup system but none are on as large a scale as the Furnace's 50 MW.

"There are no new ideas in this," Fenstermacher said. "It is an application and extension of presently known concepts. However, the scale we are doing it on is new. The fission release in this system is much greater than usual because these are 'test' elements and may be unclad. Power reactors presently operating use clad elements and containment vessels to minimize or eliminate fission product release."

In the cleanup system the exhaust from the Furnace is flowing at the rate of about four pounds per second, or 800 standard cubic feet per second, or 48,000 standard cubic feet per minute. This exhaust, at a temperature range of 3,500°F to 4,500°F, contains a power of 50 MW. The exhaust also contains those fission products which have been released from the elements during the test.

The initial step in the effluent cleanup is to reduce the high temperature so that ordinary materials, i.e., steel, can be used in the system. This is accomplished by injecting water which flashes to steam and drops the temperature to about 700°F. The effluent is now a mixture of steam and gaseous hydrogen, but the power of 50 MW is still present.

The next step in the system is to begin heat removal by the use of heat exchangers.

The exhaust is now passed through tubes inside a large kettle boiler. The clean water in the kettle is flashed to steam at a rate of about 100,000 pounds per hour. This steam is vented to the atmosphere. The exhaust, still containing fission products, is thus cooled to about 300°F at the exit of this heat exchange. About 80 per cent of the power—roughly 40 MW—is removed in this step.

In the next phase the effluent is run through a series of heat exchangers known as the "Economizer," the "Cooler" and the "Chiller."

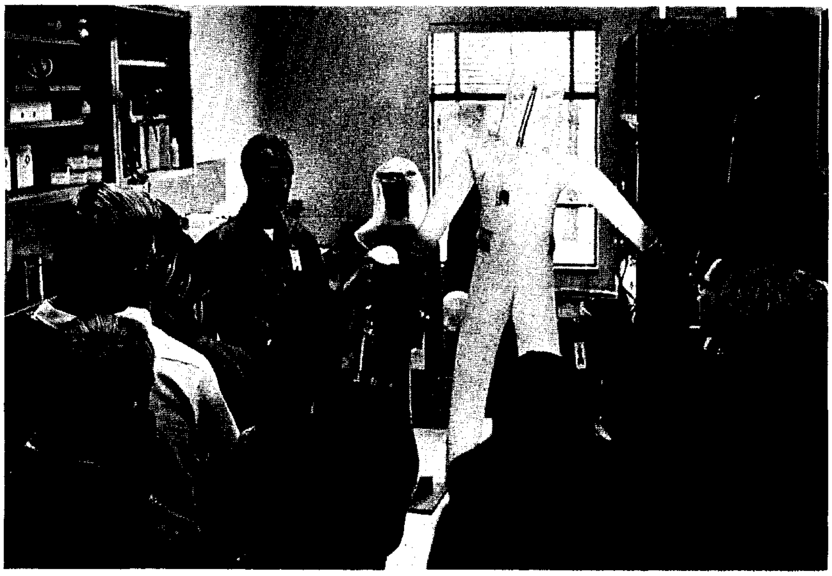
The Economizer exchanger drops the temperature to 180°F by heat exchange with water. It is known by this name because the cooling water used here is also used to feed the boiler after its use in this exchanger, thus economizing on the use of water.

Now the exhaust is fed into the Cooler where the temperature is dropped to 60°F by heat exchange with cold hydrogen. Then the exhaust goes through a silica gel bed which removes all water from the effluent. This water must be removed or it would later freeze and block subsequent flow passages in the system. The exhaust, now composed of dry gaseous hydrogen and fission products, is further reduced in temperature by passage through the Chiller, another hydrogen-to-hydrogen heat exchanger. At the end of the Chiller, the temperature is about minus 100°F. The temperature is then lowered to minus 150°F by the addition of about a half-pound per second of liquid hydrogen.

At this point the hydrogen with the fission products is routed through a charcoal bed—which contains some 5,000 pounds of charcoal—and the fission products, primarily xenon and krypton, are absorbed. Operation of the bed at these low temperatures increases its absorptive capacity and hence reduces the amount of charcoal required. The effluent leaves the charcoal bed at a temperature of approximately minus 150°F and this hydrogen is used as the coolant in the Chiller and Cooler in a regenerative fashion.

As a result of this heat exchange the temperature of the effluent rises back to plus 120°F and this effluent is carried to the flare stack and burned off.

The first test of the Furnace is scheduled for NRDS in early 1970. If this test, and subsequent ones, are successful, LASL could some day be testing fuel elements in a Furnace located at one of its technical areas on "The Hill."



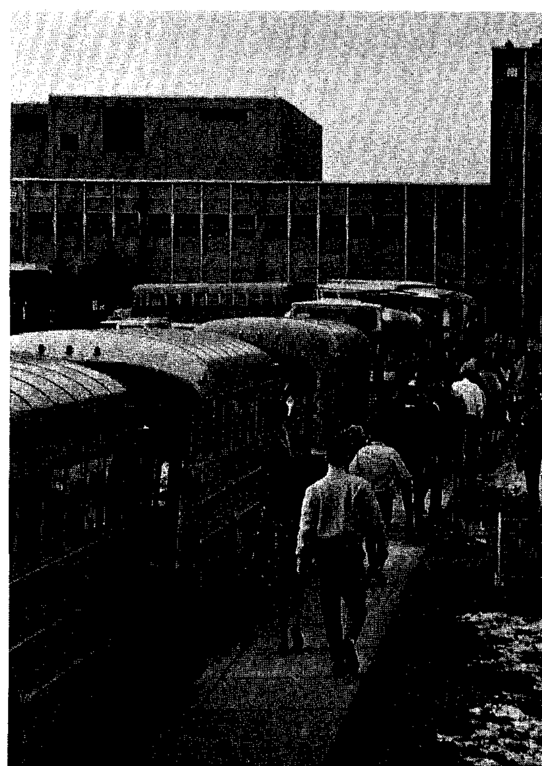
Above: Jacque Cote, Los Alamos, tried Humco II for size at HRL. Humco II is a liquid scintillation whole body counter capable of measuring the natural radioactivity of the human body.

Below: Laboratory Director Norris E. Bradbury welcomes students to the 13th annual Science Youth Days at LASL. Bradbury told the students science was fun but was "a demanding mistress."

James DeField, H-5, demonstrates part of the various types of protective clothing used by personnel of the Laboratory.

Left: Robert Warner, K-4 group leader, explains the operation of UHTREX (Ultra High Temperature Reactor Experiment) to students from Pojoaque and Taos high schools. In the foreground is the control panel for the reactor.

Right: a portion of the hundreds of high school science seniors who participated in Science Youth Days pile out of their buses and file into the auditorium for the opening series of lectures.



Science Youth Days

By Bob Brashear

Science Youth Days, the 13th gathering of the high school science-clan at Los Alamos, drew more than 650 students from 38 high schools in eight states this year.

A new format for handling the annual observance included a special opening-day preview of lectures and laboratories for some 100 science students from Los Alamos High School, April 16. In addition, a group of 24 Los Alamos students—tagged "honor guides"—helped the Community Relations staff host the out-of-town students who visited on the subsequent two days—April 17 and 18.

Kent Bulloch and Tom Langhorst of Pub-2, were co-chairmen of Science Youth Days this year. They arranged for the young scientists to meet LASL Director Norris Bradbury; James Tuck, P-DO, speaking on controlled thermonuclear reactions; L. D. P. King, dir. off., on reactors; and John Wooten, C-7, on computers. While the students and advisors lunched, they saw a movie on Project Rover—nuclear power for space flight. Robert Y. Porton, PUB-2 group leader and veteran of all 13 Science Youth Day observances, was master of ceremonies at the morning-long orientation sessions in the laboratory auditorium. During the afternoons the youngsters toured laboratory sites to get a first-hand look at LASL science research and scientists.

PUB-2 members who aided in tour coordination included Joyce Miller, Sue Wooten, Luz Woodwell, Mary Gilmore and R. W. Brashear. They directed work of the honor guides who rode buses to the sites and acquainted visiting students with Laboratory and community backgrounds.

Besides New Mexico, students came from Maine, New Hampshire, Wyoming, Colorado, California, Arizona, and Texas. For the seventh year in a row, a group of Los Angeles High School students—specially selected through school-wide competition visited the laboratory. The

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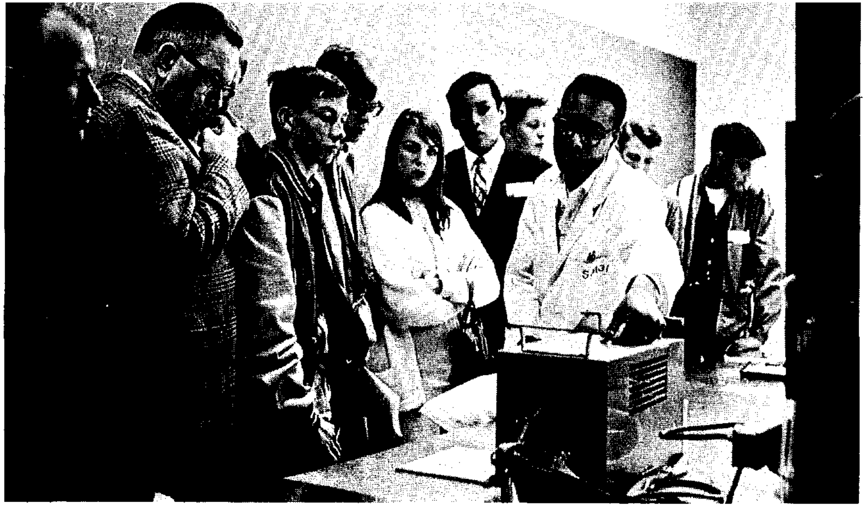
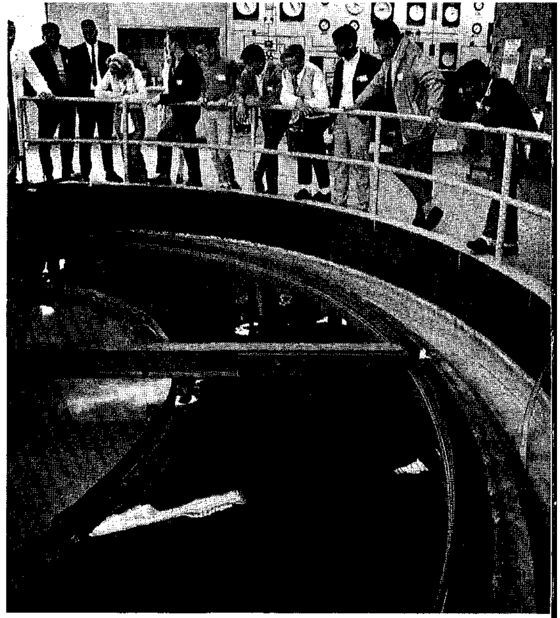
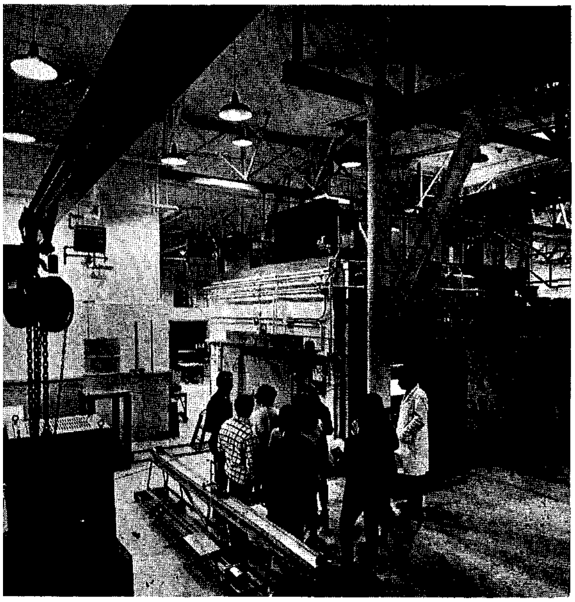
Dale Henderson, P-13, discusses LASL's Sherwood Project—controlled thermonuclear research—with a group of high school science seniors.

Los Alamos High School students assisted the Laboratory in the 13th annual youth days program. Here, Phyllis Gotti (left) and David Weinstein demonstrate the computer at the Van de Graaff facility.



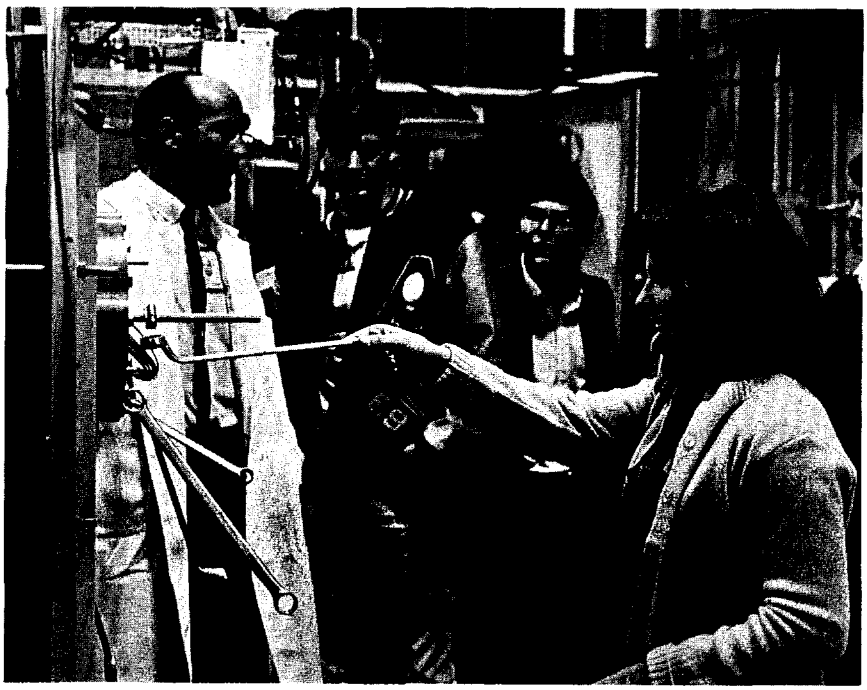




Above: Fred Toca, H-5, talked about the various types of toxic gases to the students touring the Occupational Health Laboratory.

Left: Roger Morris, GMX-1 (at left) discusses research carried on at Omega Site.

The forces of a magnetic field were demonstrated by Don Michael, P-13, during the Sherwood tour. Attempting to pull a wrench away from the electron cyclotron heating (ECH) machine is Gail Lemons of Los Alamos. In the background, also from Los Alamos, are Paul Gray and Tony Cherry.



Science Youth . . .

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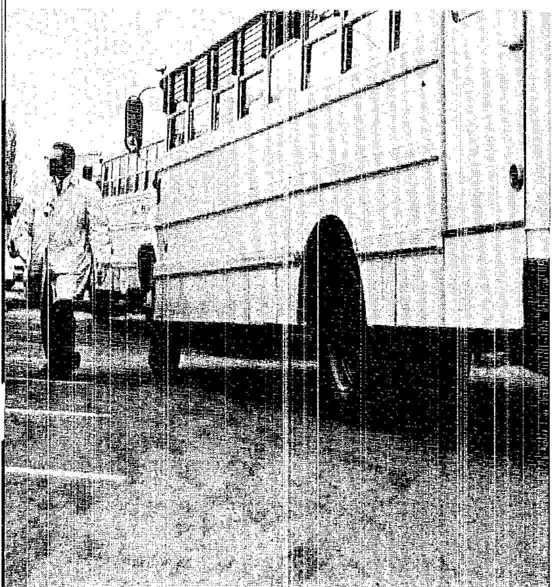
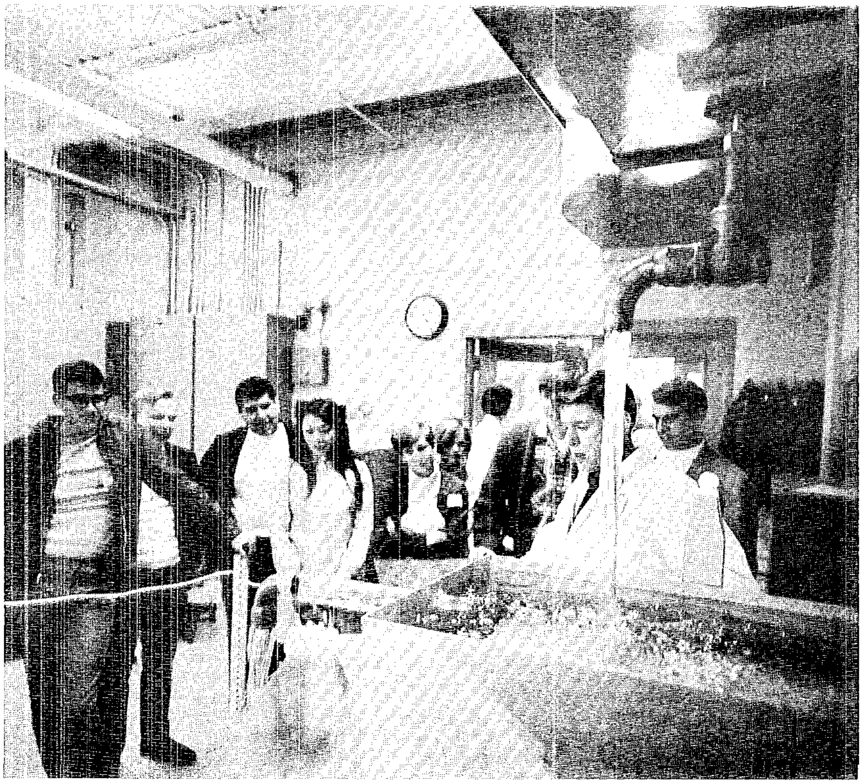
Arizona contingent included students from Alhambra, Camelback, Central, Maryvale, Phoenix Union and South Mountain High Schools of Phoenix.

More laboratory sites were utilized this year to cut down on the tour load for Laboratory guides. Students were taken each afternoon into Health Research laboratory, Occupational Health laboratory, the Sherwood laboratory, Radioac-

The precipitator at TA-50—the radioactive waste disposal site—is explained to a group of Gallup students by Ray Garde, H-7, left.

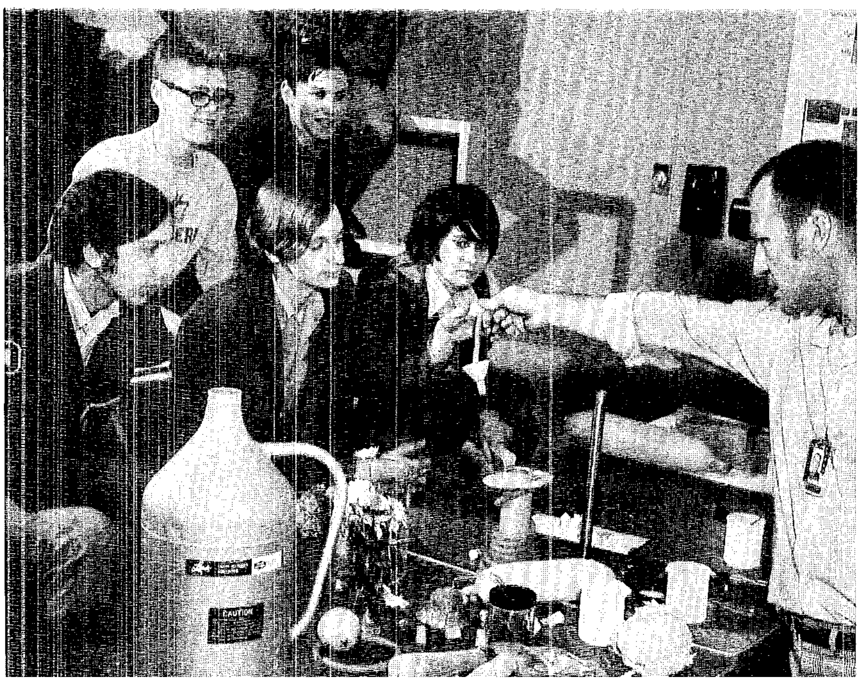
Tom Langhorst (left) and Kent Bulloch, both of PUB-2, were this year's Science Youth Days coordinators.





The science involved with "Reverse Hydrolysis"—a phenomenon occurring only at TA-50—is explained by Jim Trout, PER-1. In this process, water is condensed from the room's atmosphere and made to flow through the pipe. (Actually, the water is flowing from the tank, up through a clear pipe where it overruns and flows back down on the outside.)

Science Youth Days were also recently conducted at the Nuclear Rocket Development Station, northwest of Las Vegas, Nev. Ed Logan, J-17, right, conducted a demonstration in cryogenics for the visiting students. Approximately 300 students from Clark and Nye County schools attended the event at NRDS.



tive Liquid Waste Disposal laboratory, the Meson Physics Accelerator site, the Ultra High Temperature Reactor at Ten site, Omega Reactor site, and the Van de Graaff Accelerator laboratory.

Science Youth Days originated as the annual observance of inventor Thomas A. Edison's birthday. It was held in February throughout the early years, and then moved into April in order to insure a better chance for good weather. At the Nevada Test Site, however, Science Youth Days were held in February.

The World's Largest
Nuclear Safeguards Program

--obstacle for ambitious memories--Autobahn for constructive imagination

In an incredibly short span of time many uses and potential uses of the atom have been realized for the benefit of man who remembers its angry beginning and recognizes its constructive possibilities. Both purposes have been pioneered by the ingenuity of Americans who now seek to share their technology with other nations of the world, many of which cannot otherwise afford the benefits of nuclear energy.

But, lest those who receive these benefits value ambitious memories more than constructive imagination, the United States has, since the beginning of its atomic energy program, attached stringent national and international controls to any agreement for the use of its nuclear material and equipment.

Today the nuclear industry, not only in the United States but in other countries which also have nuclear capabilities, is enjoying unprecedented growth, especially since 1966 when worldwide interest in nuclear energy for the production of electrical power began its current rapid expansion. Greater quantities of nuclear material and equipment are now being transferred within and between nations. It has been recognized by the nations who control this flow of material and equipment—notably the United States, Soviet Union, Canada, France and England—that more effective national and international controls are needed to deter any possibility that one nation's jealousy or distrust of another will lead to stockpiling and eventually, perhaps, use of nuclear weapons.

In recognition of this need, the Atomic Energy Commission in mid-1967 established a new office of Safeguards and Materials Management headed by Delmar L. Crowson and a new Division of Safeguards in its Regulatory Branch headed by Russell P. Wischow. The AEC also appointed a National Advisory Committee on Nuclear Materials Safeguards, and research and development programs were begun to advance techniques and methods for safeguarding, or keeping strict account, of nuclear materials.

In the United States the world's largest Nuclear Safeguards Research and Development program was centered at the Los Alamos Scientific Laboratory where most facets and operations typical of the nuclear industry are practiced. Since its beginning in December of 1966 the program has had notable success in the development of prototype instrumentation that is expected to make significant contributions toward national and international control of nuclear materials.

N-Division Nuclear Physicist, G. Robert Keepin, who but a short time before had headed the Physics Section, Division of Research and Laboratories of the International Atomic Energy Agency (IAEA) in Vienna, Austria, was named to head Group N-6 which was created to carry out LASL's nuclear safeguard program. Two safeguards laboratories were established, at Pajarito and Ten sites, and a committee of 18 members whose group or division activities are directly concerned with nuclear materials and equipment was organized to identify practical applications for testing and proving newly developed safeguards techniques. Its membership includes LASL Technical Associate Director Raemer E. Schreiber; N-Division Leader Roderick W. Spence and Alternate Division Leader Franklin P. Durham; Keepin and N-6 Staff Members Roddy B. Walton, Ronald H. Augustson, Carl N. Henry, Howard O.

Menlove, Munson M. Thorpe, Larry V. East and Joerg H. Menzel; CMB-Division Leader Richard D. Baker; CMB-11 Group Leader William J. Maraman and Alternate Group Leader Joseph A. Leary; CMB-8 Group Leader Richard J. Bard and Alternate Group Leader Alfred C. Dumrose; CMB-1 Group Leader Charles F. Metz; Engineering Department Head L. Philip Reinig; and ENG-6 Group Leader Robert H. Hendron.

To implement new, more stringent, safeguards and accountability requirements, the Atomic Energy Commission sought to develop assay techniques having certain distinct advantages over conventional chemical and mass spectrometer methods of analysis. Although accurate, these conventional methods are expensive, time-consuming and destructive in that the sample to be analyzed must be essentially destroyed or consumed in the process of analysis. Another problem in chemical assay is that samples which are truly representative of the total bulk material to be assayed are difficult to obtain, especially when the material is heterogeneous, insoluble or otherwise not amenable to "wet chemistry" processing. In contrast, the new techniques were to be direct physical methods for the detection, identification and analysis of nuclear material in unknown mixtures; they were to be nondestructive, rapid, accurate and capable of being carried out under a wide range of laboratory and field conditions.

The nondestructive assay methods under development by Group N-6 have been divided into two categories. One, known as *passive assay,* involves the use of a detector to obtain characteristic "signatures" of gamma rays and neutrons which are naturally emitted from fissionable material. This method, however, has limitations because neutrons and gamma rays are emitted from only certain types of material, and the gammas are of such low energy and short range that they cannot penetrate thick materials in which they might be contained. Neutron emissions are useful for detection of the fissionable element plutonium, but the method is accurate only if isotopic ratios of different plutonium isotopes in the sample are known. The second method of assay, called *active interrogation,* avoids most of the limitations of passive assay. It involves the use of a neutron source to produce fissions in the material under study and a detector to record the resulting fission-produced neutrons and gamma rays. Neutrons and gamma rays produced by fission can be either "prompt" or "delayed." Those that are emitted immediately following fission are said to be prompt while those emitted for sometime (several minutes) after fission are called delayed.

At Los Alamos emphasis has been placed on delayed-neutron signatures. The reason is that interrogation by the source neutrons occurs in pulses so there is a convenient time separation between these pulses and subsequent emission of delayed neutrons. There are two approaches to detecting, identifying and analyzing nuclear materials using delayed neutrons. One is based on delayed-neutron yield, or in other words, the number of delayed neutrons emitted per fission. Using this method, the number of delayed neutrons detected can be directly related to the amount of fissionable material present. Furthermore, discrimination between fissionable isotopes can be accomplished by varying the energy of interrogating neutrons.

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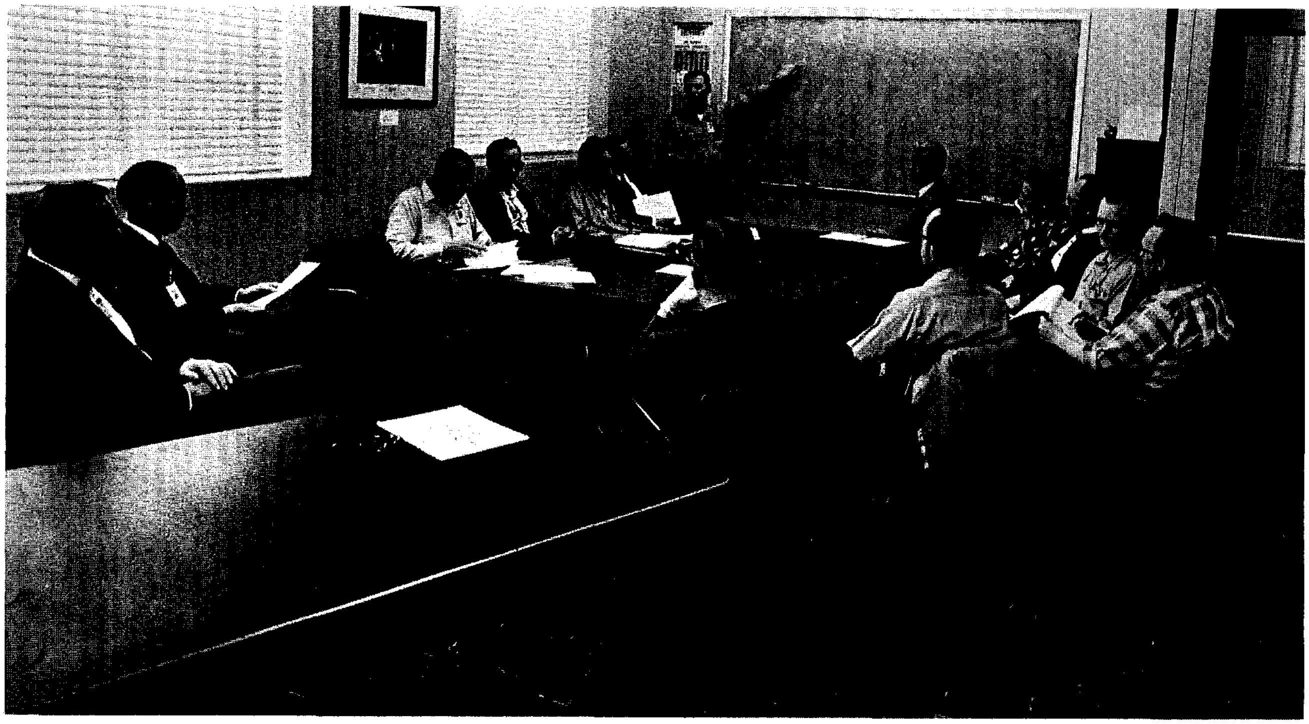
A "shirtsleeve" study session evolved during the recent visit and tour of the LASL nuclear safeguards program facilities by Delmar Crowson, second from right, director of the Office of Safeguards and Materials Management, and Samuel McDowell, Crowson's assistant director for research and development. At left is LASL Technical Associate Director Raemer E. Schreiber and, at right, N-6 Group Leader G. Robert Keepin.



Munson Thorpe, N-6, illustrates a point during one of the regular monthly meetings of the N-6-CMB Nondestructive Assay committee. In foreground are L. Philip Reinig, Engineering department head, and Richard D. Baker, CMB-division leader. At left of table are Alfred C. Dumrose, CMB-8 alternate group leader; Carl Henry and Larry East, both N-6; and Charles Metz, CMB-1 group leader. At right are William Maraman, CMB-11 group leader; Alan Berick, Ronald Augustson, and Roddy Walton, all of N-6; Robert Hendron ENG-6 group leader; Joerg Menzel, N-6; and G. Robert Keepin, N-6 group leader. Not shown is N-Division Leader Roderick Spence.

Walton and Berick, in white laboratory coats, demonstrate a passive gamma-ray assay technique for determining plutonium content within a large blast-containment vessel to Joe Mascarenas and Roderick Day, both CMB-11, at DP site.

Nuclear Safeguards . . .

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Some isotopes, such as uranium-238 and thorium-232, for example, require higher energy neutrons to produce fission than do uranium-235, plutonium-239 and uranium-233. If the energy of the source neutrons is kept below the fission threshhold of uranium-238 and thorium-232, fissions from only uranium-235, plutonium-239 and uranium-233 will occur. In laboratory experiments the accuracy of the delayed-neutron yield method has been proven to be within one per cent of chemical assay standards.

The second assay approach, known as the kinetic response method, consists of pulsing neutrons into an unknown sample and observing the rate at which delayed neutrons are emitted from it as a function of time. In general, delayed neutrons from fission are emitted in six "decay groups" having half-lives ranging from two-tenths of a second to 55 seconds. The amounts of delayed neutrons

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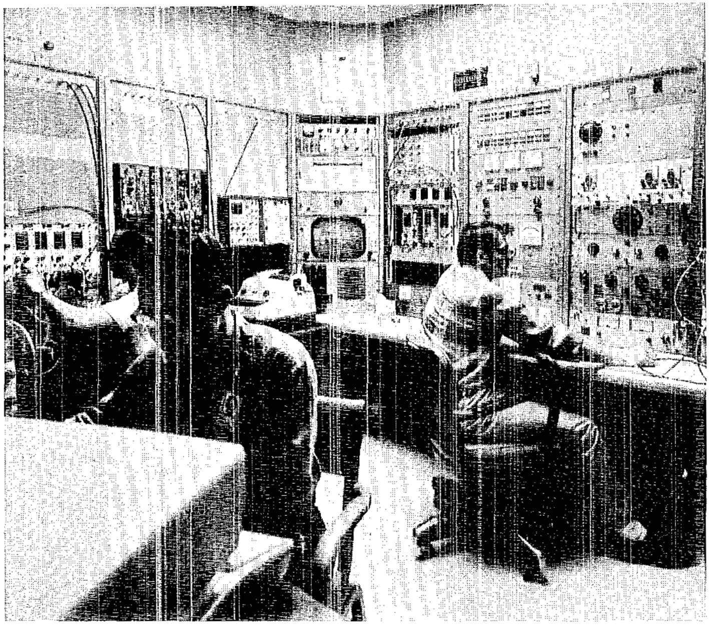

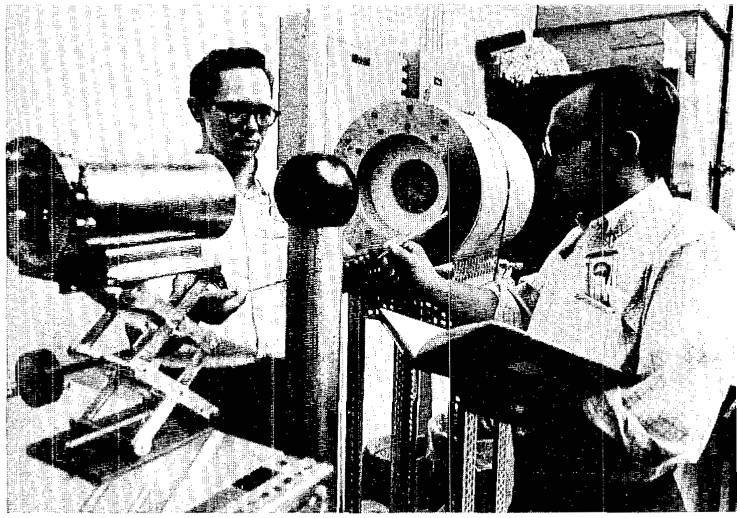

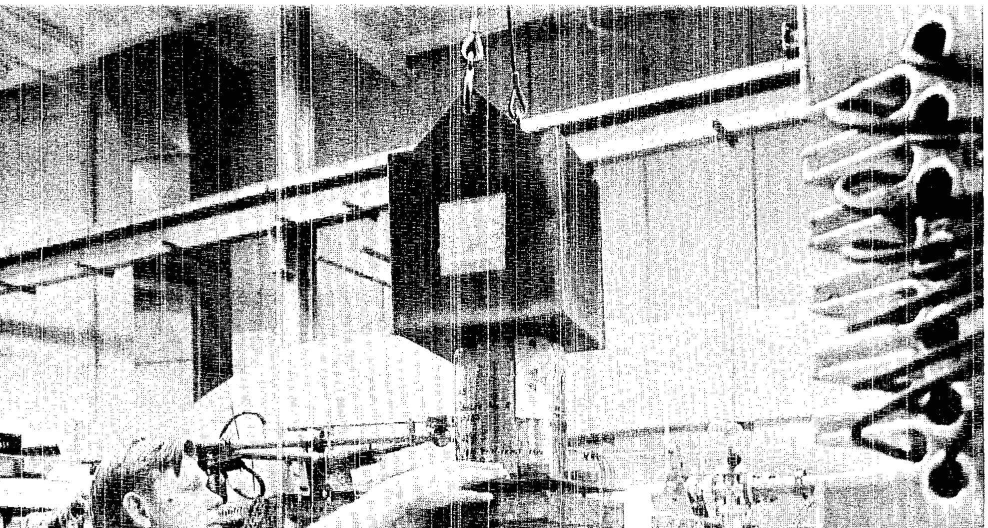

At the console of the N-6 Cockcroft-Walton accelerator at Pajarito site, upper left, Tom Whittlesley operates the accelerator controls while Darryl Smith, foreground, and Henry check out data acquisition equipment. Left: Thorpe positions a container of Rover fuel-material scrap near the target of the Cockcroft-Walton for assay by neutron interrogation techniques as Henry records information on the sample. At upper right in the photo is the neutron detector for the assay. Top: Henry and Christopher Masters prepare to measure the delayed-neutron kinetic response of a uranium sphere using the compact "Zipper" pulsed-neutron generator, at left, developed by the Sandia Corporation. The neutron detector is at rear. Above: Berick and Walton insert uranium-235 foils into a polyethylene sphere in preparation for a measurement of fission delayed-gamma-rays induced by neutrons from the Cockcroft-Walton accelerator at rear.

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emitted either early or late is different for each kind of fissionable material, making it possible to determine the relative amounts of the various fissionable isotopes contained in the material under interrogation. Accuracy to within two to three per cent has been attained using this method. Under certain conditions, isotopic assay can be best performed using a combination of the delayed-neutron yield and kinetic response techniques.

Before these assay methods can be effectively applied certain fundamental data is required. For example, basic measurements of delayed-neutron yield versus the energy of the neutrons inducing fission are required to relate the measurement of delayed neutron response to the amount of fissionable material. Delayed-neutron yields of the major fissionable isotopes have been measured by Group N-6 at energies of three MeV and 14 MeV. The LASL results showed a decrease in absolute yield at the higher neutron energy, which was expected theoretically, but they are in direct contradiction to previous measurements at other laboratories in the United States and the Soviet Union. The high yields at 14 MeV obtained in the earlier measurements are believed to be attributable to neutron back-scattering effects from the detector. Below three MeV, LASL results show that absolute delayed-neutron yields for the fissionable materials measured are essentially constant, which is of considerable practical importance in the development of nondestructive assay methods based on delayed-neutron yields.

Delayed gamma rays as well as prompt neturons and gamma rays may also be used either in combination with delayed neutrons, or separately, to provide characteristic signatures of the various fissionable materials. In the so-called "black box" case of unknown mixtures of fissionable and non-fissionable materials, the combined measurement of both delayed-neutron and gamma-ray response provides important additional information about the materials surrounding, or interspersed with, the fissionable material under investigation. Such combined measurements can also provide two confirmatory determinations of fissionable material content.

Other methods of active interrogation will compliment and expand the capabilities which have been demonstrated by the delayed-neutron assay methods. One, "resonance self-indication," employs a steady-state beam of slow neutrons which is passed through the fissionable sample under study to a series of detectors containing the same fissionable isotopes that are in the sample; proper interpretation of the response from each of the detectors results in self-indication of each isotope present in the sample. A portion of the work in developing this method was carried out at the Water Boiler Reactor facility at Omega site. Two methods being studied to discriminate between thermally fissioning isotopes are based on measurements of absolute delayed-neutron yields and delayed-neutron fractions (delayed-to-prompt neutron yield ratios).

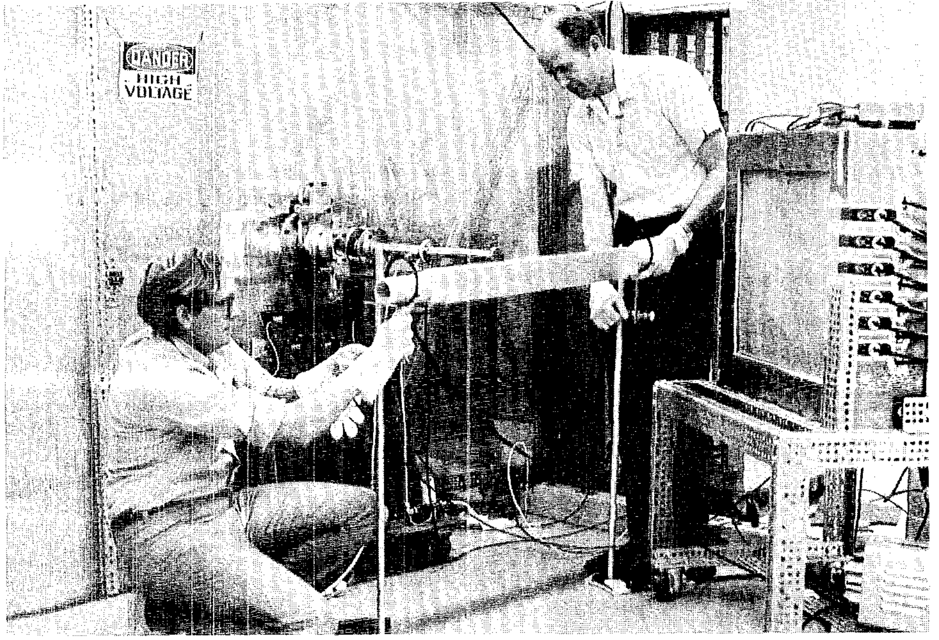
The accelerators used as neutron sources in the LASL research and development program are commercially produced, but modified and adapted to the needs of the safeguards program. Keepin noted that although photon sources meet some of the requirements for active interrogation, and are being investigated by Gulf General Atomic Corporation in California, neutron sources were selected for the safeguards program at Los Alamos because neutrons are capable of penetrating nearly all nuclear materials; they provide a means for incisive isotopic discrimination; and, they are readily available in simple, inexpensive and compact units.

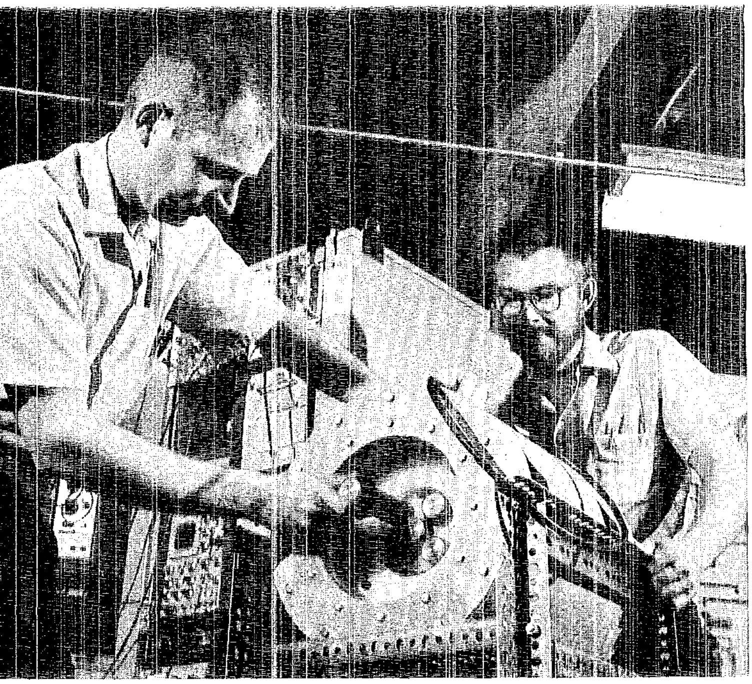
Extremely high-efficiency neutron and gamma detectors, based on an extension of state-of-the-art technology, have been developed by N-6 personnel. The neutron detectors represent "very significant advances in the development of high-efficiency, flat-response (independent of energy) neutron detectors," Keepin said. He noted that the LASL program from its inception has placed strong emphasis on developing maximum-sensitivity neutron and gamma-ray detectors so that interrogating-neutron-source strength, associated personnel hazards and shielding requirements, can be minimized.

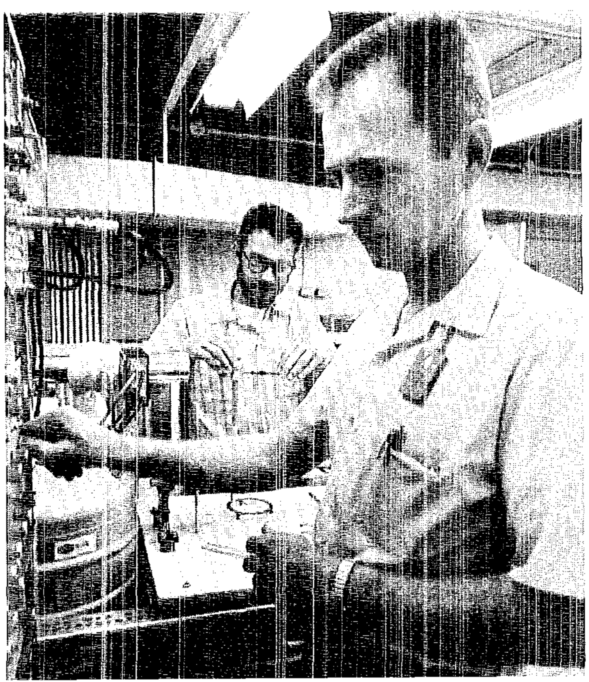
Applications of the new nondestructive assay techniques have been largely centered around the "fuel cycle," which refers to the series of steps involved in supplying fuel for nuclear power reactors beginning with mining and continuing through fabrication of fuel elements, their use in a nuclear reactor, reprocessing to recover the fissionable materials present in a "burned-up" or "spent" element and finally, purification and refabrication into new fuel elements. These steps are generally representative of the major areas of the nuclear power industry.

The reason for placing so much emphasis on the fuel cycle can readily be seen when it is under-

Right: Augustson and Howard Menlove position an MTR reactor fuel element which will be assayed for uranium-235 content. The pulsed neutron accelerator used as the interrogation source is in the cage at left, and the large "slab" neutron detector used to measure delayed neutron response is at right. Below: East and Melvin Stephens assemble a high-efficiency "long-counter" used for basic measurements of delayed neutron yields per fission. Bottom: East, foreground, adjusts pulse-height analyzer equipment while Stephens prepares a sample of MSBR fuel to be assayed by passive gamma counting for the amount of thorium-232 and uranium-233 present in the sample.







stood that any nuclear power reactor must contain at least one of the three "strategic" nuclear materials—uranium-235, plutonium-239 or uranium-233—that can be used to create and sustain a fission chain reaction. Uranium-235 is the only one of the three that exists in nature. The other two materials—plutonium-239 and uranium-233—are by-products of power-reactor operation. Plutonium-239 results from the fissioning of uranium-238, and uranium-233 from the fissioning of thorium-232.

Uranium-235, plutonium-239 and uranium-233 are also the key components of nuclear fission weapons. Clearly then, reactors used for power generation are also a source of nuclear materials which, if not properly controlled, could be used in a clandestine weapons program. Atomic Energy Commission Chairman Glenn T. Seaborg has projected that plutonium will be produced in nuclear-power reactors throughout the world by 1980 at the rate of more than 100 kilograms a day, or in other words, an amount sufficient for production of a substantial fraction of the world's electrical power or, alternatively, sufficient for making tens of nuclear weapons a day.

Practical applications of the nondestructive assay methods being developed at Los Alamos have been divided into three major categories inherent to the nuclear fuel cycle; these are reactor fuels, small test samples and fissionable-material scrap. Keepin said that the capability of nondestructive assay methods for determining the amounts of uranium-235 in MTR-type fuel elements, such as those used in the LASL Omega West reactor, has already been demonstrated with accuracy of bet-

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ter than one per cent. He noted that similar accuracy was demonstrated when the element was contained in a mock-up lead shielding cask. "We have done assay on the Oak Ridge MSBR (Molten Salt Breeder Reactor) fuel and have been able to determine absolute amounts of fissionable materials, again, to within the order of one per cent accuracy," he said.

Small test samples including fissionable material standards, prototype and experimental materials, compounds, mixtures, and process-line samples in various physical and chemical forms are being provided for nondestructive assay by the AEC, which obtains them in the course of safeguards inspection visits to nuclear industrial plants in the United States. The samples are being assayed by nondestructive methods at Los Alamos, and the results are being compared directly with the conventional chemical analysis of the same samples at the AEC's New Brunswick Laboratory. The New Brunswick Laboratory is considered to be the AEC's authority and final arbiter on chemical assay techniques and analyses, Keepin said. "Our assay results of the AEC inventory samples agree with the chemical assay performed by New Brunswick to within about one per cent accuracy for absolute fissionable material content and on the order of two per cent for isotopic composition," he said.

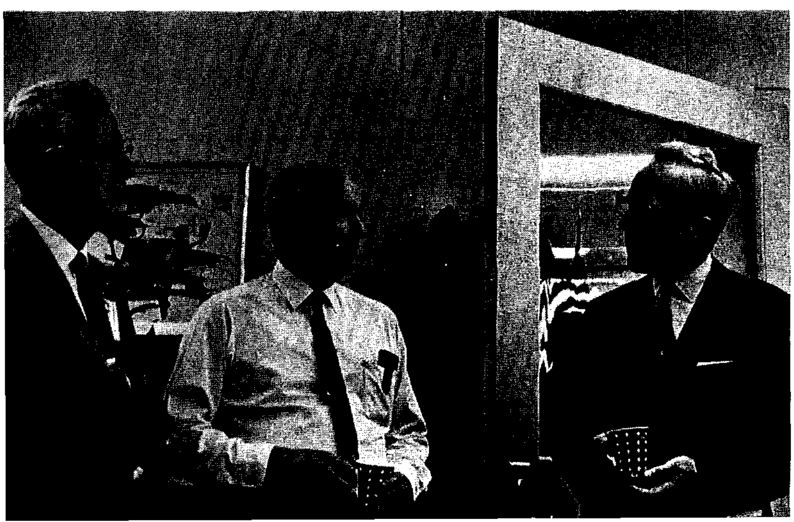
Nondestructive assay methods have been applied to analysis of fissionable scrap material from isotope separation, fuel reprocessing and fuel fabrication plants. This problem of assay of fissionable scrap is one of urgent and growing concern to the AEC, the N-6 group leader said. Most of the scrap assayed in the LASL program has been produced in the nuclear rocket propulsion program (Project Rover). Keepin said preliminary measurements of Rover scrap, which is contained in two-gallon cans, indicate that gram quantities of fissionable materials can be assayed with an accuracy on the order of five per cent or less. Fissionable scrap assay has been guided by computer simulation studies.

The new assay methods also promise extensive applications to nuclear materials management, accountability, quality control, plant efficiency, economy and safety when they are made available to the nuclear industry. Similarly, the AEC's Division of Military Application has expressed interest in applying the techniques to on-the-spot inspection and assay of weapons-grade fissionable material in production and fabrication facilities, to practical in-the-field problems of verification of weapons integrity as well as the integrity of components, mock-ups and dummy systems for weapons development, diagnostics and testing.

This new technology, while being used for inspecting and policing nuclear materials in this country and in others which it has provided with nuclear equipment, will also be shared with other countries and organizations of the world to insure more effective international control. The reason for stressing the international aspect of safeguards inspection and control of nuclear materials was amply explained by Keepin in an address at the American Nuclear Society's National Topical Meeting on Coupled Reactor Kinetics in 1967: "The question of who applies these safeguards is also of fundamental importance. At the outset, there was no alternative to having this function performed by the United States itself. No one else had the capability. Accordingly, the Atomic Energy Commission developed the necessary staff and techniques to undertake this responsibility. To date our U.S. inspection staff has carried out more than 400 inspections in 26 countries throughout Europe, Latin America and the Middle and Far East.

"But it was recognized from the start that the full advantages of safeguards could be realized only if they were carried out by an international organization approaching world-wide membership. The advantages of international safeguards over bilateral safeguards such as we have had in the past are not always clearly understood. If the sole objective of safeguards were to assure us alone that

Talking with Schreiber and LASL Director Norris E. Bradbury during his recent inspection tour of the Laboratory's Nuclear Safeguards Research and Development program facilities is Sigvard Eklund, director general of the International Atomic Energy Agency.



Eklund and Keepin discuss LASL's safeguards program and applications to future IAEA inspection methods as they tour the Nuclear Safeguards Research laboratory at Ten site.

assistance we provide is not diverted to military purposes, then we might well argue that nobody can provide the U.S. with better assurance than Uncle Sam's own true-blue inspectors! But the problem is far broader than that. The plain fact of the matter is that in many countries, an assurance based on American inspection alone simply would not be acceptable. It is important that the world at large be satisfied that the peaceful nuclear assistance provided by the United States is just that, and is not being used for military purposes. Of even greater importance is the fact that more and more nations now can and do provide nuclear assistance to other countries. If we relied on bilateral safeguards alone in this situation, some nations might apply effective controls, other nations—through indifference or inability—might apply ineffective or wholly inadequate controls, while still others might apply no controls at all. Because of the competitive commercial pressures that exist in the international nuclear-power market, the end result of all this might well be a reduction to the least common denominator—i.e., no safeguards at all."

To assure effective international control of nuclear materials, the new safeguards techniques being developed at Los Alamos and elsewhere have been pledged by the United States for the technical implementation of a future world-wide inspection and control system to be administered by the International Atomic Energy Agency. The IAEA is an arm of the United Nations which grew out of the United States "Atoms for Peace" program that was initiated in 1953 by President Eisenhower. The organization, whose members represent nearly all United Nations countries, has been designated as the international police force for the Nuclear Non-Proliferation Treaty which to date has been ratified by many nations. The treaty, aimed at limiting the spread of nuclear weapons, was recently approved by the United States Senate and is expected to be approved by the Soviet Union in the near future, Keepin said. While the treaty does not impose explicit obligations on countries with their own nuclear capabilities President Johnson, in December of 1967 announced ". . . We are trying to assure that the peaceful benefits of the atom will be shared by all mankind without increasing the threat of nuclear destruction. We do not believe that the safeguards we propose in that treaty will interfere with the peaceful activities of any country, and I want to make it clear to the world that we in the United States are not asking any country to accept safeguards that we are unwilling to accept ourselves, so I am today announcing that when such safeguards are applied under the treaty, the United States will permit the International Atomic Energy Agency to apply its safeguards to all nuclear activities in the United States—excluding only those with direct national security significance. . . ."

In October of last year Sigvard A. Eklund, director general of the IAEA, visited the Los Alamos Scientific Laboratory specifically to inspect the nuclear safeguards facilities and review, in detail, its research and development program. In the course of his visit Eklund stated the IAEA's dependence on the technological development of safeguards in several countries and particularly the new inspection and assay techniques being developed at Los Alamos in the United States.

"In the sense that we have developed prototype assay instrumentation in the laboratory, we already have at hand several very effective safeguards techniques, but these need to be adapted and engineered to produce reliable, compact field equipment that can be used routinely in industrial nuclear facilities and in the field with a minimum

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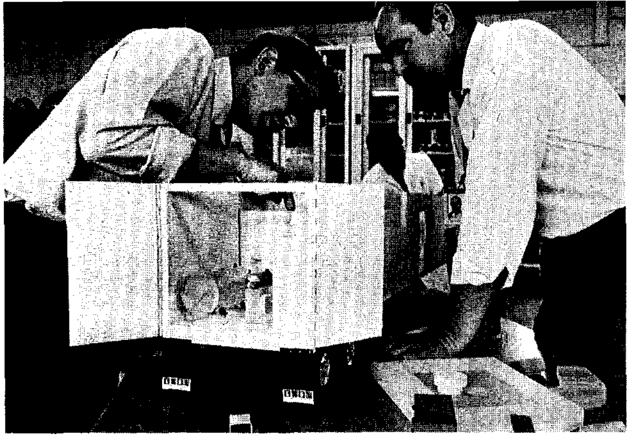
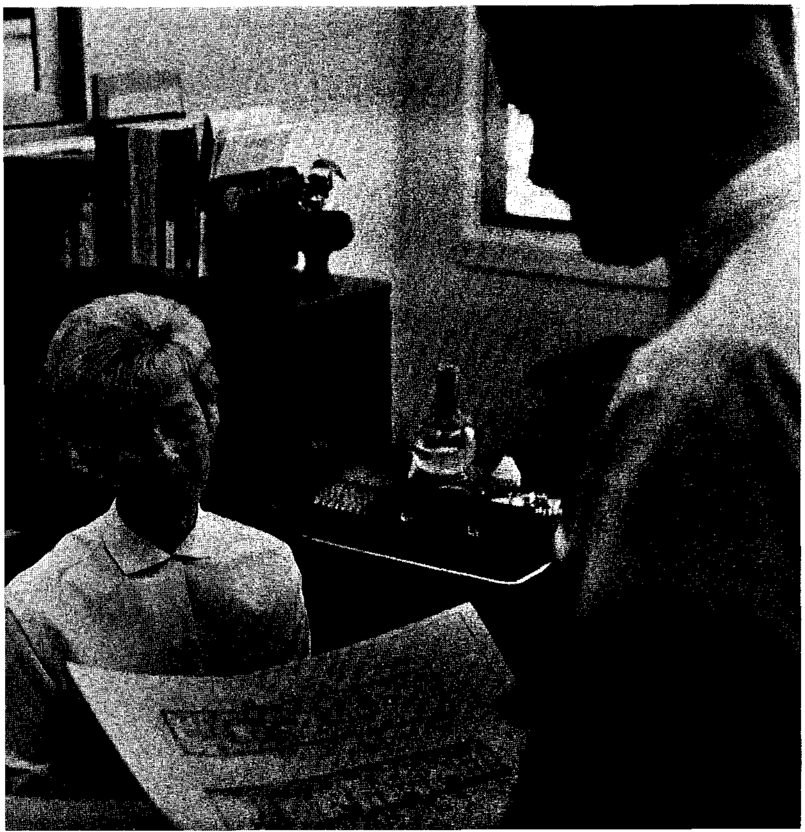


Upper Right: Menzel and Don Sterner, ENG-2 model shop, inspect a scale model of LASL's Mobile Safeguards Assay Laboratory which is under construction. The model's rear access doors are open, revealing the rear equipment room containing a pulsed-neutron interrogation-source, high-voltage supply tank and air-conditioning unit. At rear is Bruce Martinez, ENG-2. Above: Munson Thorpe and Thomas Capelli load an unknown sample of fissionable material to be assayed into the "shuffler," a pneumatic device used to transfer samples from the point of neutron irradiation to the large neutron detector with entrance hole at left. Prototype "FFTF" fuel pellets for the AEC's fast breeder reactor program have been analyzed using this experimental arrangement in the Nuclear Safeguards Research Laboratory at Ten site. A pulsed neutron accelerator is behind the screen at rear. Below: Group N-6 Secretary Pat Turner checks final specifications for the Mobile Safeguards Assay Laboratory van with Keepin who holds a schematic of the van.



Nuclear Safeguards . . .

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of difficulty and intrusion," Keepin said in describing the progress of the LASL program in relation to its basic goals.

The state of the program's maturity is evidenced by plans to incorporate nondestructive assay instrumentation into a Mobile Safeguards Assay Laboratory which is presently under construction at LASL. Designed by Group N-6 and the LASL Engineering department, it is slated for completion in October of 1969. After a testing period of several weeks at Los Alamos, the unit will be used to demonstrate the new assay techniques in various nuclear plants and facilities around the United States and perhaps abroad, Keepin said.

The AEC's Advisory Committee on Nuclear Materials Safeguards will hold its spring meeting at Los Alamos May 15; committee members will be briefed on the LASL safeguards program and will inspect its laboratories at Ten site and Pajarito site.

Keepin asserts that present safeguards research and development is only the beginning of a very promising future for nondestructive assay methods and their applications to accountability, process and quality control, and materials management problems throughout the nuclear industry. "Due to our successes in obtaining high accuracy and sensitivity in nondestructive assay, and the relative simplicity of the instrumentation we have developed, new applications for our techniques seem to be cropping up all over." He noted for the expanding nuclear power industry of the 1970's, a major technical requirement will be to keep safeguards technology and instrumentation abreast of the increasingly complex physical and chemical forms in which special nucler materials will be utilized. A new safeguards laboratory building to meet expanding future requirements has been proposed for construction west of the road entering TA-35 on Pajarito Road.

Voices of experience were heard in Los Alamos during

The Career Information Series

Donald C. Liebenberg, CMF-9, speaks to a group of high school students on careers in Astrophysics during the April series of career information lectures.

A series of 27 lectures and panel discussions at Los Alamos High School during the past two months have been given by people of experience in a variety of occupational fields. The Career Information Series, as the event was known, provided interested high school and junior high school students and their parents with the opportunity to hear men and women from different parts of New Mexico talk about their careers, the training that is required and where it is offered, and why the work is satisfying to them. Sponsored by the Los Alamos Parent-Teacher Association and the High School Guidance Department, it was a new approach to informing local students of career opportunities.

Among lecturers and panel members taking part in the series were 19 from the Los Alamos Scientific Laboratory. Harlan M. Averitt, WSD, spoke on "Technicians: The Field, the Training and the Pay;" Harry F. Schulte, H-5, "Health Careers;" Donald F. Petersen, H-4, "Careers in Biomedical Research;" Edward R. Laymen, PER-DO, "Personnel Administration;" Robert A. Penneman, CMB-4, Sherman W. Rabideau, CMF-2, D. Lloyd Williams, H-4, George R. Shepherd, H-4, and Glenn R. Waterbury, CMB-1, panel discussion on "Chemistry;" Helen F. Redman, D-2, "Opportunities in Libraries and Information Centers;" Arno P. Roensch, SD-3, "Glass Blowing;" Bill Jack Rodgers, PUB-1, "Futures in Photography;" William

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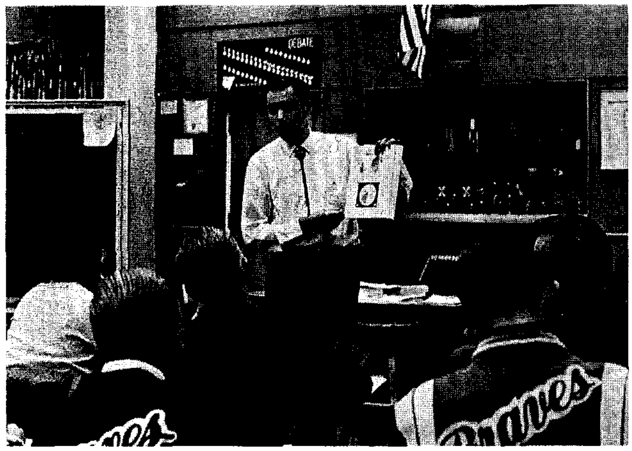
Answering questions of students attending his lecture on "Dentists and Related Dental Careers" is Los Alamos Dentist Dr. Gilbert C. Luna.



Liebenberg illustrates his talk to Los Alamos students which included such supporting fields as telescope making.

Career Information...

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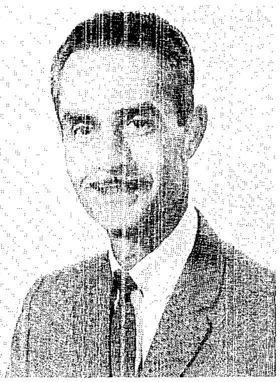
G. Hudgins, T-1, "Data Processing;" Donald Liebenberg, CMF-9, "Astrophysics;" Frederick C. V. Worman, H-DO, "Anthropology;" John F. Buchen, CMB-7, "Scientific Instrumentation;" John C. Biery, K-2, Robert I. Brasier, ENG-DO, Mique S. Talcott, ENG-7, panel discussion on "Chemical Engineering."

Others from Los Alamos to speak were Paul Noland, county administrator, "Challenges in Local Government;" Edwin Stockly, attorney, "Law and Politics;" Betty Wallwork, teacher, "Psychology;" Harry Siemer, gunsmith, "Gunsmithing;" Dr. Rufus Lee, pediatrician, "The Practicing Physician;" Virginia Glass, nurse, "Careers in Nursing;" Dr. Gilbert C. Luna, dentist, "Dentists and Related Dental Careers;" Markley McMahon, Los Alamos Monitor, "The Newspaper Business;" Darrel K. Burns, KRSN radio station, "Opportunities in Broadcasting;" Mae Ann Grady, beautician, "The Beauty Business."

Lecturers from other parts of the state were George Gliva, family and marriage counselor, Santa Fe, "Social Work: Do-Gooders or a Profession;" Garrett Boyd, airline senior sales representative, Albuquerque, "Airline Careers;" Bill Fegan, managing director of the Kaleidoscope Players and director of the New Mexico School for the Performing Arts, Raton, "The Performing Arts: Stage, Cinema and Television;" Jack Sampson, state supervisor, Bureau of Apprenticeship, U.S. Department of Labor, Albuquerque, "Apprenticeship Programs in New Mexico."

short subjects

Wright H. Langham, H-4 group leader, will deliver the Fourth Annual Harry G. Armstrong Lecture at the Aerospace Medical Association's Scientific Meeting May 5-8 in San Francisco. Langham's talk is entitled, "Radiobiological Factors in Manned Space Flight."



The Armstrong Lecture is sponsored by the Association and supported by Smith Kline and French Laboratories. Each year the lecturer is chosen from among physicians and scientists who are outstanding in a particular field related to areas of aerospace medical disciplines.

Armstrong is an internationally recognized authority on aviation and space medicine and former president of the Association.

Stanley James Winters, casual technician with CMB-6, died March 19 in Espanola. Winters was also employed by the AEC Fire Department. He is survived by his wife, Barbara, and two children, Mrs. Sharon Ann Patrick and Barry Lee Winters. Services were held in Chapel of the Valley in Espanola and interment was in the national cemetery in Santa Fe.

Evelyn Peters, H-DO, commander of Flotilla 58, U.S. Coast Guard Auxiliary in Los Alamos, has been presented an Olin Marine Safety Award by New Mexico Governor David Cargo.

The award is "For an outstanding contribution, in the fields of writing, search and rescue, training or education, that advances the cause of safe boating." It is presented each year to no less than five nor more than 10 persons in the United States.

Allie May Allen, SP-3 assistant stock records supervisor, retired April 4 after almost 15 years with the Laboratory. She and her husband, Harleigh, SD-5, have built a home in the valley.

Jack Hill, a machinist with the Shops department since 1947, retired April 11. Hill plans to maintain a small machine shop in Espanola on a part-time basis.

Charles E. Pohlman, ENG-2 senior designer, retired April 30 after more than 13 years with the Laboratory. For two years prior to his employment at LASL, he was with an architectural firm and served as field engineer during construction of the Administration building. Pohlman will continue to reside in Santa Fe.

Margaret Bensen, PER-3, retired May 2, after almost twenty years with the Laboratory. She had been employed in the Personnel Department for the entire time. After a long California vacation, Mrs. Bensen will return to Los Alamos. Her husband, Norman is employed in CMB-8.

Willard H. Beattie, W-7, has accepted the American Institute of Chemists' invitation into Fellowship. Welcoming ceremonies were held at the Fellows dinner in Santa Fe last month.

A patent recently made available for public use by the Atomic Energy Commission is the ^{2}N ^{4}N ^{6}N-Tripicrylmelamine for which **M. D. Coburn,** GMX-2, is listed as inventor.

The patent-name chemically describes a heat-resistant explosive that is insensitive to impact.

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city state zip code

new hires

C division

Delfinio H. Vigil, Espanola, N.M., C-1

CMF division

Richard N. Buteau, Skowhegan, Maine, CMF-5

BMX division

James D. Guidry, Opelousas, La., GMX-3

J division

John S. Beardall, Springville, Utah, J-10

MP division

Francis D. Michaud, Ames, Iowa, MP-6.

P division

Ronald C. Rosul, Monessen, Pa., P-3

Richard E. Siemon, Hannibal, Mo., P-15

James R. Lemley, Cedar Rapids, Iowa, P-3 (postdoctoral)

Shops department

Roswell W. Mitchell, Sr., Los Alamos, SD-1

W division

Thomas L. Cordell, Houston, Texas, W-3

The Technical Side

Presentation at American Astronomical Society Special Meeting on Solar Astronomy, Pasadena, Calif., February 18-21:

"A Solar Flare Disturbance in the Interplanetary Medium" by Joan Hirshberg, NASA Ames Research Center, Moffett Field, Calif., S. J. Bame, P-4, and A. J. Hundhausen, T-12

Presentation at colloquium at University of New Mexico, Department of Physics and Astronomy, Albuquerque, Feb. 28:

"Medium Energy Nuclear Physics" by R. L. Burman, MP-6

Presentation at 20th Pittsburgh Conference on Analytical and Applied Spectroscopy, Inc., Cleveland, Ohio, March 2-7:

"Nondestructive Incremental Mass Measurement of Rover Fuel Elements by Gamma Ray Absorption" by B. L. Blanks and M. A. Winkler, both GMX-1, and A. Christian, N-1

Presentation at conference on Computer Systems in Experimental Nuclear Physics, Skytop Club, Skytop, Pa., March 3-6:

"Parasitic Use of an On-Line Computer-Based Data System" by J. S. Levin and M. P. Kellogg, both P-9, R. B. Perkins and E. T. Ritter, both P-DOR

"Programming Language and Physics Research" by M. B. Wells, C-7

Presentation at Particle Accelerator Conference, Washington, D.C., March 5-7:

"A Compact Data Acquisition and Control Terminal for Particle Accelerators" by D. R. Machen, R. A. Gore and D. W. Weber, all MP-1

"A Digital Resonance Control System for the Drift-Tube Linac" by J. B. Sharp, MP-1, and G. R. Swain, MP-3

"A Fast Protection System for Linear Accelerators"by D. T. Van Buren, MP-1

"The Injector Complex for the LAMPF Accelerator" by P. W. Allison, C. R. Emigh and R. R. Stevens, Jr., all MP-4

"Linear Light Link Data Transmission" by E. C. Budge, MP-1

"Microwave Instrumentation for Accelerator RF Systems" by R. A. Jameson, W. J. Hoffert and D. I. Morris, all MP-2

"PCM Data Transmission System Using Split Phase Code" by E. C. Budget, MP-1

"A Pulse-Signal Viewing System for Accelerators" by D. T. Van Buren and H. C. Maddocks, both MP-1

"Remote Maintenance Concepts for the Los Alamos Meson Physics Facility" by M. T. Wilson, MP-6

"Test of LASL Ion Source with 200-kV Pierce Accelerating Column" by C. R. Emmigh, E. A. Meyer, and D. W. Mueller, MP-4

"A Unique High Duty Factor Series Hard-Tube Modulator for Use in the Los Alamos Meson Physics Facility" by J. R. Faulkner, MP-2

"A Versatile Technique for Interfacing a Control Computer with Remote Data Acquisition and Control Station Along Particle Accelerators" by F. R. Terry, MP-1

Presentation at University of Toronto, Canada, March 6:

"Some Aspects of NMR Studies in Solids" by Eiichi Fukushima, CMF-4

Presentation at National Association of Purchasing Management Meeting, Las Vegas, Nev., March 11:

"Relationship Between Quality Control and Purchasing" by C. D. Fine, J-9 NRDS

Presentation at American Nuclear Society Meeting Idaho Falls, Idaho, March 11-13:

"Characterizing Compositions of Irradiated Fuel at Operating Temperatures--Future Needs" by C. F. Metz and G. R. Waterbury, both CMB-1

"Characterizing the High Temperature Thermophysical and Thermochemical Properties of Irradiated Fuels--Present Status and Future Needs" by A. E. Ogard, J. G. Reavis and J. A. Leary, all CMB-11

"Examination of Fast Reactor Fuel Elements with a Lithium-Drifted Germanium Anticoincidence Gamma-Ray Spectrometer" by D. M. Holm, R. M. Sanders, both K-1, J. L. Parker, K-5, and Helen D. Cowan, K-1

"Radiographic Inspection of Hot Reactor Fuel Assemblies Using the 22 MeV Betatron" by D. E. Elliott and J. F. Torbert, both GMX-1

Presentation at Optical Society of America Meeting, San Diego, Calif., March 11-14:

"Accurate Least-Squares Calculation of Large Atomic-Energy-Level Arrays" by L. J. Radziemski, K. J. Fisher, and D. W. Steinhaus, all CMB-1

Optimization of Czerny-Turner Spectrographs" by J. V. Kline, CMB-1, P. E. Rouse, GMX-2, and B. Brixner, GMX-9

Presentation at second conference on Nuclear Isospin, American Physical Society, Asilomar, Calif., March 13-15:

"Resonance Structure in the ^{88}Sr (p,p') Octupole Transition" by E. R. Cosman, P-DOR, R. Kalish, MIT, Cambridge, Mass., D. D. Armstrong, P-12, and H. C. Britt, P-DOR

Presentation at seminar on Technical Information, sponsored by Trinity Chapter of Society of Technical Writers and Publishers, Fort Bliss, El Paso, Texas, March 14:

"Taking the Noise out of Technical Writing" by J. W. McDonald, D-6 (invited)

Presentation at Semi-Annual AEC Computer Information Meeting, Stanford University, Calif., March 17-18:

"Los Alamos Scientific Laboratory Computer Activity Report" by T. L. Jordan, C-DO

Presentation at meeting of North Texas Section of American Nuclear Society, Fort Worth, March 18:

"Los Alamos--The Community and Hot Cell Facilities" by J. R. Lilienthal, CMB-7

Presentation at colloquium at the University of Houston, Texas, Physics Department, March 20:

"Dense Plasma Focus," by P. J. Bottoms, P-7

Presentation at seminar at University of Illinois, Urbana, March 20:

"Positive Pion, Proton-Proton Reactions in Light Nuclei" by R. L. Burman, MP-6

Presentation at University of Edmonton and University of Calgary, Canada, March 20 and 21:

"Changes in Magnetotail Plasma Associated with Magnetospheric Substorms" by E. W. Hones, P-4 (invited)

Presentation at meeting of the New Mexico Branch of the American Society of Microbiology, Socorro, March 21-22:

"Host-Parasite Relationships in Malignancy: The Energy Metabolism of Normal and Malignant Cells" by C. T. Gregg, H-4

"Response of Haemophilus Influenzae to Ultra-violet Light" by B. J. Barnhart, S. H. Cox and G. J. Kantor, H-4

Presentation at American Crystallographic Association Meeting, Seattle, Wash., March 23-29:

"The Crystal Structure of $Cu_3(NH_3)_4(CN)_4$" by R. J. Williams, D. T. Cromer and A. C. Larson, all CMF-5

"Crystal Structure of Iso-Structural Hydrazinium Perchlorate and Hydrazinium Flouborate" by J. W. Conant, N-1, and R. B. Roof, CMF-5

"A Simple Algorithm for Plotting Electron Density in Stereo" by A. C. Larson, CMF-5

"Thermal Motion in Sodium Aluminum Sulfate Dodecahydrate" by M. I. Kay, Puerto Rico Nuclear Center, and D. T. Cromer, CMF-5

Presentation at American Physical Society Meeting, Philadelphia, Pa., March 24-27:

"Band Structure, Compressibility and Pressure Dependence of the Superconducting Transition Temperature of FCC Lanthanum" by E. A. Kmetko, CMF-5

"Hall Effect in Oriented Alpha Plutonium" by T. R. Loree, CMF-5, and H. T. Pinnick, University of Akron, Ohio

"Magnetic Properties of Dysprosium Platinum 3 and Dysprosium Indium 3" by G. P. Arnold and N. G. Nereson, both P-2

"*Molecular Beam Kinetics: Energy* Disposal in the Reacton $Cl + Br_2 \rightarrow ClBr + Br$" by J. B. Cross and N. C. Blais, both CMF-4

"Self-Consistent Field Function" by D. A. Liberman, T-4

Presentation at Seventh Annual Symposium on Biomathematics and Computer Science in the Life Sciences, Houston, Texas, March 26-28:

"Growth and Division of Mammalian Cells in Synchronized and Exponential Populations" by G. I. Bell, T-DOT (invited)

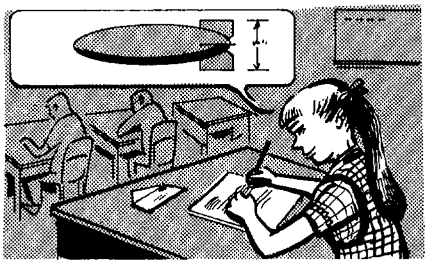
Presentation at Sandia Laboratory, Albuquerque, N.M., March 27:

"Uranium Dioxide-Uranium Dinitride-Uranium Phase Equilibria" by R. Benz, CMB-3

Presentation at University of New Mexico Medical School Student Organization, UNM Medical School, Albuquerque, March 29:

"Mesons and Medicine" by L. Rosen, MP-DO

20 years ago in los alamos



Culled from the May, 1949, files of the Los Alamos Skyliner by Robert Y. Porton

Hill Plays Host to Scientists

It was "old home week" at the Los Alamos Scientific Laboratory when the biennial information meeting last week was attended by many of the pioneers in nuclear research, some for the first time since their departure after the war's end. Los Alamos hosted the meeting for the first time, and more than 150 scientists came to report on progress and discuss information. Among those who exchanged reminiscences about the old days were Victor Weisskopf, Robert Serber, E. O. Lawrence, Edward McMillan, Emilio Segre, Joseph Kennedy, Glenn Seaborg, Luis Alvarez, H. H. Barschall, George Weil and Bernard Weinstock.

New Members Named to AEC

Gordon Dean and Henry DeWolf Smyth have been named as members of the Atomic Energy Commission by President Truman to replace former Los Alamosan Robert F. Bacher and William W. Waymack both of whom had resigned. Dean is a professor of law at the University of Southern California and is a practicing attorney; Smyth, author of the "Smyth Report," is a professor and chairman of the Physics Department at Princeton University.

Kids Ask for Bomb Plans

The mysteries of nuclear fission and atomic weapons are everyday stuff for today's youngsters, or so it would seem from a letter recently addressed to the AEC at Los Alamos by a high school girl in Troy, New York. "Dear Sirs," the letter began. "My science class in our high school is doing some research on atomic energy. Would you please send me some information and some drawings on the atom bomb and its structure." The young lady was sent a copy of the Fifth Semi-Annual Report of the Atomic Energy Commission, accompanied by a gentle note covering security regulations.

Junior Museum Is Planned

Sparked by James C. Hobart, president of the Los Alamos Mineralogical Society, hopes for a Junior Science Museum here took shape Wednesday afternoon when interested adults gathered at the office of Earle D. Sullivan, assistant manager for Community Affairs. In Palo Alto, California, Mr. Hobart recently investigated such a museum which is a part of the community center there.

what's doing

MESA PUBLIC LIBRARY: May 1-21, New Mexico photographers' circulating exhibit from the Museum of New Mexico.

SIERRA CLUB: Luncheon meeting at noon, first Tuesday of each month, South Mesa Cafeteria. For information call Brant Calkin, 455-2468, Santa Fe.

RIO GRANDE RIVER RUNNERS: Meetings scheduled for noon, second Tuesday of each month at South Mesa Cafeteria. For information call Cecil Carnes, 672-3593.

OUTDOOR ASSOCIATION: No charge; open to the public. For information on May schedule, call Ken Ewing, 8-4488.

NEWCOMERS CLUB—Tasting party, May 28, 6:30 p.m., Recreation Hall. For information call Mrs. Ruth Talley.

PAJARITO FIELD ARCHERS: Business meeting fourth Monday of every month. Shooting nightly, leagues now forming. For information call Leland Zollars, president, 2-4043.

LOS ALAMOS COUNTY HISTORICAL MUSEUM—Open Tuesday, Thursday, and Saturday, 2 to 4:30 p.m. For information call Mrs. Mary Byers, 8-4348.

LOS ALAMOS ARTS COUNCIL: May 18, 7:30 p.m. Fuller Lodge, reading, "Devils of Loudun," with musical accompaniment, directed by Ed Purrington, Santa Fe. For information call Mrs. Ruth Sherman, 8-4980.

SPORTSMAN'S CLUB: Meeting, third Thursday of every month, club house in Rendija Canyon, 7:30 p.m.; Basic Pistol Marksmanship course, 7:30 p.m. each Monday, April 14 through May 19. For information call Bob Newell, 8-4135, or John Yarnell, 8-4450.

CHORAL SOCIETY: Concert, May 18, 8:15 p.m., Catholic Church. Handel's "Israel in Egypt." For information call John Ward, 8-4554.

PUBLIC SWIMMING: High School Pool—Mondays through Fridays, starting May 1, from 7:30 to 9 p.m., and Saturdays and Sundays from 1 to 6 p.m.; Adult Swim Club, Sundays, 7 to 9 p.m.

TOASTMASTERS: The newest Los Alamos Toastmasters Club meets the second and fourth Mondays of each month at noon at the South Mesa Cafeteria.

Joseph Mather, P-7 group leader, left, and Richard Taschek, P-division group leader, right, talk with Lev A. Artsimovich, academician-secretary of the Department of Physics and Mathematics of the Academy of Sciences of the U.S.S.R. who recently spoke at the Los Alamos Scientific Laboratory on "Russian Controlled Thermonuclear Reactor Programs." Highlight of Artsimovich's talk was "Tomak", a device "which has achieved spectacular results on the path toward thermonuclear reactors," Taschek said.

BACK COVER:

The Los Alamos Scientific Laboratory is responsible for the design and development of the nuclear explosive for Project Rulison—a Plowshare event scheduled for western Colorado. Laboratory representatives have been at the site for several weeks. Here, Robert Campbell, J-DO, Earl Rutledge, J-1, and Darrell Davidson, J-8, discuss the project at ground zero site. The natural gas production stimulation experiment will occur about 40 air miles northeast of Grand Junction, Colo.

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